

## MILITARY SPECIFICATION

## PAPER, CHEMICAL AGENT DETECTOR, VGH, ABC-M8

This specification is approved for use by all  
Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 This specification covers one type of commercial paper incorporating three dyes which react with liquid chemical agents.

## 2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## MILITARY

- MIL-P-51409 - Paper, Chemical Agent Detector, VGH, ABC-M8; Booklet of.
- MIL-D-51410 - Dye, Green, Ethyl-Bis(2,4-Dinitrophenyl) Acetate (EDA).
- MIL-D-51411 - Dye, Yellow, Thiodiphenyl-4,4'-Diazo-Bis-Salicylic Acid.
- MIL-D-51412 - Dye, Red, 2,5,2',5'-Tetramethyltriphenylmethane-4,4'-Diazo-Bis-Betahydroxynaphthoic Anilide.

## STANDARDS

## MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated,

MIL-P-51408(EA)

the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

- D585-68 - Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Product.
- D586-63 - Ash in Paper.
- D645-67 - Thickness of Paper and Paperboard.
- D646-67 - Basis Weight of Paper and Paperboard.
- D828-60 - Tensile Breaking Strength of Paper and Paperboard.
- D829-48 - Wet Tensile Breaking Strength of Paper and Paper Products.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

TECHNICAL ASSOCIATION OF PULP AND PAPER INDUSTRY (TAPPI)

- T441M-45 - Water Absorptiveness of Nonbibulous Paper and Paperboard (COBB Test).

(Application for copies should be addressed to the Technical Association of Pulp and Paper Industry, 360 Lexington Avenue, New York, New York 10017.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

Munsell Book of Color

(The Munsell Book of Color may be obtained from the Munsell Color Company, Inc., 2441 N. Calvert Street, Baltimore, Maryland 21218.)

3. REQUIREMENTS

3.1 Dyes. The green, yellow, and red dyes used in the manufacture of the paper shall conform to MIL-D-51410, MIL-D-51411, and MIL-D-51412, respectively.

3.2 Manufacture. The paper shall be manufactured from a strong-bleached sulfite or sulfate pulp product containing sufficient additives and dyes to meet all the requirements of this specification (see 6.5).

3.3 Physical characteristics. The paper shall conform to the physical characteristics of table I when tested as specified therein.

Table I. Physical characteristics

Characteristic	Requirement	Test paragraph:
Average basis weight, grams per square meter	80 $\pm$ 5	4.3.1
Thickness, mils	5.60 $\pm$ 1.40	4.3.2
Ash content, percent by weight	1.0 maximum	4.3.3
Dry tensile strength, pounds per inch:		4.3.4
Machine direction	25 minimum	
Cross machine direction	9 minimum	
Wet tensile strength, pounds per inch:		4.3.5
Machine direction	6.2 minimum	
Cross machine direction	2.3 minimum	
Sizing, grams per square meter gain	17.5 maximum	4.3.6
Average absorption time, seconds, for 1 drop (0.015 milliliter) of:		
Ethylene glycol monomethyl ether	30 maximum	4.3.7.1
Methyl salicylate	45 maximum	4.3.7.2

3.4 Color. The color of the paper shall match one of the Munsell colors listed in table II when tested as specified in 4.3.8.

Table II. Munsell colors for paper

Hue	Value	Chroma
5.OYR	9	1
5.OYR	8	1
10.OYR	8,9	1,1
10.OPB	9	1
10.OR	8	1
10.OP	9	1
5.OPB	9	1
5.OY	8.5,9	1,1
N	9	
N	9.5	

3.5 Dye content. The paper shall contain the amount of dyes specified in table III when tested as specified therein.

Table III. Dye content of paper

Dye	Percent by weight	Test paragraph
Red dye conforming to MIL-D-51412	0.6 $\pm$ 0.2	4.3.9
Green dye conforming to MIL-D-51410	1.0 $\pm$ 0.3	4.3.10
Yellow dye conforming to MIL-D-51411	1.3 $\pm$ 0.3	4.3.11

3.6 Simulant agent response. A visible color stain shall be produced on the paper within 30 seconds using one drop (approximately 0.2 milliliter) of each simulant agent when tested as specified in 4.3.12.

3.6.1 Yellow dye. When a G-agent simulant is applied to the paper, the stain produced by the yellow dye shall match one of the Munsell colors listed in table IV.

Table IV. Munsell colors for yellow dye stain

Hue	Value	Chroma
5.0YR	6	8
7.5YR	6	6
7.5YR	5	6
10.0YR	7	6
2.5Y	6	5,6,8

3.6.2 Green dye. When a V-agent simulant is applied to the paper, the stain produced by the green dye shall match one of the Munsell colors listed in table V.

3.6.3 Red dye. When an H-agent simulant is applied to the paper, the stain produced by the red dye shall match one of the Munsell colors listed in table VI.

3.7 Rolls. The paper shall be furnished in rolls only. When booklets are required, they shall be assembled in accordance with MIL-P-51409.

Table V. Munsell colors for green dye stain

Hue	Value	Chroma
5.0Y	3	2
5.0Y	4	2,4
7.5Y	5	4,5
7.5Y	6	4
10.0Y	4	2,4
2.5GY	3	4
2.5GY	4	4
2.5GY	5	6
5.0GY	4	3
5.0GY	3	2
5.0GY	5	2,4
5.0BG	3.5	2
5.0BG	4	1
10.0BG	4	2
5.0B	4	1
10.0B	4	1,2
5.0PB	3	1
5.0P	3	1

Table VI. Munsell colors for red dye stain

Hue	Value	Chroma
7.5RP	5	12
2.5R	3	8
2.5R	4	4,6,7,10
2.5R	5	4,6,9,12
2.5R	6	7
5.0R	5	8
7.5R	4.5	8
10.0R	4	6

3.8 Workmanship. The paper shall be uniform in color when viewed at a distance of 5 feet with no specks, spots, light or dark patches and shall be free from holes, cuts, tears, thin spots, wrinkles, creases, grease, oil, dirt or other foreign matter.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as

otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to specified requirements.

#### 4.2 Quality conformance inspection.

4.2.1 Lotting. A lot shall consist of the paper produced by one manufacturer, at one plant, from the same materials, and under essentially the same manufacturing conditions. However, a lot shall contain no more than one batch (see 6.3) of any ingredient.

#### 4.2.2 Sampling and inspection procedure.

4.2.2.1 For examination. Sampling shall be conducted in accordance with MIL-STD-105. The sample unit shall be one roll of paper. Sample rolls of paper shall be examined in accordance with the following classification of defects:

<u>Categories</u>	<u>Defects</u>
<u>Critical:</u>	None defined
<u>Major:</u>	AQL 2.5 percent defective
101	Damage (see 3.7)
102	Contamination (see 3.7)
103	Color not uniform (see 3.7)

4.2.2.2 For test. Sampling shall be conducted in accordance with ASTM D585-68. Samples shall be tested as specified in 4.3. Failure of any test shall be cause for rejection of the lot of paper represented.

4.3 Tests. Reagent grade chemicals shall be used throughout the tests. Where applicable, blank determinations shall be run and corrections applied where significant. Tests shall be conducted as follows:

4.3.1 Average basis weight. Determine the average basis weight of at least 10 samples in accordance with ASTM D646-67.

4.3.2 Thickness. Determine thickness in accordance with method A of ASTM D645-67.

4.3.3 Ash content. Determine ash content in accordance with ASTM D586-63.

4.3.4 Dry tensile strength. Determine dry tensile strength in accordance with ASTM D828-60.

4.3.5 Wet tensile strength. Determine wet tensile strength in accordance with method B of ASTM D829-48.

4.3.6 Sizing. Determine absorption in accordance with TAPPI T441M-45.

4.3.7 Average absorption time.

4.3.7.1 Ethylene glycol monomethylether. Place an accurately measured drop 3 millimeters (mm) in diameter (0.015 milliliter) of ethylene glycol monomethyl ether on the center of a sample paper held horizontally. Measure the time required for the surface moisture to disappear. Base the results on the average of three trials.

4.3.7.2 Methyl salicylate. Repeat the test in 4.3.7.1 using an accurately measured drop 3 mm in diameter (0.015 milliliter) of methyl salicylate in place of the ethylene glycol monomethyl ether.

4.3.8 Color. Determine the Munsell color of the paper by comparison with a Munsell Book of Color.

4.3.9 Red dye content.

(a) Standard solution. Weigh to the nearest 0.1 milligram (mg) approximately 0.35 gram (g) of the red dye used to make the paper into a 500-milliliter (ml) volumetric flask. Add 350 ml of chloroform and stir to solution using a magnetic stirrer, if required. Remove the stirring bar and dilute to the volume mark with chloroform. Shake thoroughly to mix. Pipet 10 ml of the solution into a 500-ml volumetric flask, dilute to the volume mark with chloroform, and mix thoroughly.

(b) specimen solution. Cut a piece of the sample paper weighing approximately 1.2 g and weigh to the nearest 0.1 mg. Extract the red dye and green dye with five or six 20- to 30-ml portions of chloroform at room temperature. Do not allow any portion of the chloroform to contact the paper for more than 30 seconds. Transfer each extracted portions quantitatively to a 500-ml volumetric flask. Save the paper for use in 4.3.11. Dilute the combined extracts to the volume mark with chloroform and mix thoroughly. This solution is also used in 4.3.10.

(c) Procedure. Using a suitable double-beam recording spectrophotometer, 10-mm silica cells, and chloroform in the reference cell, run absorbance curves of the standard solution and of the specimen solution from 450 to 600 nanometers (nm). Read the absorbance of the standard solution and the specimen solution at  $560 \pm 4$  nm. Calculate the percent by weight red dye as follows:

$$\text{Percent red dye} = \frac{2AE}{BD}$$

where: A = Blank-corrected absorbance of specimen solution at  $560 \pm 4$  nm,  
 B = Blank-corrected absorbance of standard solution at  $560 \pm 4$  nm,  
 D = Weight of paper in grams, and  
 E = Weight of standard red dye in grams.

#### 4.3.10 Green dye content.

(a) Standard solution. Weigh to the nearest 0.1 mg approximately 0.4 g of the green dye used to make the paper into a 250-ml volumetric flask. Add 50 ml of chloroform and stir to solution using a magnetic stirring bar. Remove the stirring bar, dilute to the volume mark with chloroform, and shake thoroughly to mix. Pipet 5 ml into a 500-ml volumetric flask containing 300 ml of chloroform. Add 25 ml of ethanolamine. The ethanolamine shall be no darker than a  $6 \times 10^{-5}$  molar solution of potassium dichromate which has an absorbance of 0.22 at 430 nm. Dilute to the volume mark with chloroform and mix thoroughly. Addition of ethanolamine and final dilution of the standard solution and the specimen solution should be done at the spectrophotometer. Curves for the standard solution and the specimen solution must be read at  $120 \pm 5$  seconds after the addition of the ethanolamine.

(b) Specimen solution. Pipet 80 ml of specimen solution from 4.3.9(b) into a 100-ml volumetric flask. Add 5.0 ml of the ethanolamine specified in (a). Dilute to the mark with chloroform and mix thoroughly.

(c) Procedure. Using a suitable double-beam recording spectrophotometer, 10-mm silica cells, and a 5-percent by volume solution of ethanolamine in chloroform in the reference cell, run absorbance curves of the standard solution and of the specimen solution from 450 to 600 nm. Run zero line in the same range using a 5-percent by volume solution of ethanolamine in chloroform in both cells. Read the absorbance of the standard solution and the specimen solution at  $665 \pm 2$  nm. Calculate the percent by weight green dye as follows:

$$\text{Percent green dye} = \frac{2.5AE}{BD}$$



where: A = Blank-corrected absorbance of specimen solution at  $665 \pm 2$  nm,  
 B = Blank-corrected absorbance of standard solution at  $665 \pm 2$  nm,  
 D = Weight of paper in 4.3.9(b) in grams, and  
 E = Weight of standard green dye in grams.

#### 4.3.11 Yellow dye content.

(a) Standard solution. Weigh to the nearest 0.1 mg approximately 0.30 g of the yellow dye used to make the paper into a 250-ml volumetric flask. Add 150 ml of dimethyl formamide and stir to solution using a magnetic stirrer, if required. Remove the stirring bar, dilute to the volume mark with dimethyl formamide, and shake thoroughly to mix. Pipet 10 ml of the solution in a 1,000-ml volumetric flask, dilute to the volume mark with 0.5-percent sodium carbonate solution, and mix thoroughly.

(b) Specimen solution. Extract the yellow dye from the paper that was used for the red and green dye extraction in 4.3.9(b) with five 20- to 25-ml portions of 0.5-percent sodium carbonate solution. Transfer each extract portion quantitatively to a 250-ml volumetric flask. Extract the paper with 10- to 20-ml portions of dimethyl formamide until the extracted portion is colorless. Transfer each extract to the 250-ml volumetric flask. Dilute the combined extracts to the volume mark with dimethyl formamide and mix thoroughly. Pipet 25 ml of the solution into a 100-ml volumetric flask, dilute to the volume mark with 0.5-percent sodium carbonate solution, and mix thoroughly.

(c) Procedure. Using a suitable double-beam recording spectrophotometer, 10-mm silica cells, and 0.5-percent sodium carbonate solution in the reference cell, run absorbance curves of the standard solution and of the specimen solution from 320 to 500 nm. Run zero line in the same range using 0.5-percent sodium carbonate solution in both cells. Read the absorbance of the standard solution and the specimen solution at  $394 \pm 4$  nm. Calculate the percent by weight yellow dye as follows:

$$\text{Percent yellow dye} = \frac{4AE}{BD}$$

where: A = Blank-corrected absorbance of specimen solution at  $394 \pm 4$  nm,  
 B = Blank-corrected absorbance of standard solution at  $394 \pm 4$  nm,  
 D = Weight of paper in 4.3.9(b) in grams, and  
 E = Weight of standard yellow dye in grams.

4.3.12 Simulant agent response.

(a) G-agent simulant. Prepare a solution of 67.5 percent by volume hexylene glycol and 32.5 percent by volume 2-methoxyethanol.

(b) V-agent simulant. Prepare a solution of 14.7 percent by weight tetrahydrofurfuryl alcohol, 3.4 percent by weight N-methylglucamine, and 81.9 percent by weight diethylene glycol. Stir for at least 30 minutes and allow to stand overnight. Centrifuge and use the clear liquid as simulant.

(c) H-agent simulant. Use isoamyl salicylate.

(d) Procedure. Place one drop (0.02 ml) of each simulant on the paper and measure the time required for development of the stains. After 30 seconds, determine the Munsell colors of the stains by comparison with a Munsell Book of Color.

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing, level C. The paper, within width and length limitations as specified in the contract or order (see 6.2), shall be packaged and packed in accordance with the supplier's commercial practice in a manner to prevent damage in shipment from the supply source to the first receiving activity. Also, the paper shall be packed to meet carrier acceptance and safe delivery to destination at lowest rates in compliance with requirements of carrier rules and regulations applicable to the mode of transportation.

5.2 Marking. Packages and packs shall, as a minimum, be marked by any means which provides legibility as follows:

- (a) Noun nomenclature as cited in the contract or purchase order
- (b) National Stock Number (NSN) or part number when NSN is not given
- (c) Government contract or purchase order number
- (d) Quantity
- (e) Contractor's name
- (f) Lot number, date of manufacture, and date of pack.
- (g) Additional markings as may be required by the contract and the contractor's policies and procedures
- (h) Exterior containers shall also be marked with the appropriate address markings

6. NOTES

6.1 Intended use. The paper covered by this specification is intended for use in detecting the presence of and distinguishing between chemical agents V, G, and H in liquid form.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Length and width of paper per roll (see 5.1).

6.3 Batch. A batch is defined as that quantity of material which has been manufactured by some unit chemical process or subjected to some physical mixing operation intended to make the final product substantially uniform.

6.4 Significant places. For the purpose of determining conformance with this specification, an observed or calculated value should be rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off method of the Recommended Practices for Designating Significant Places in Specified Limiting Values (ASTM E29).

6.5 Manufacture. Satisfactory detector paper has been manufactured from a strong-bleached sulfite or sulfate pulp containing 2 percent rosin, no more than 4 percent aluminum sulfate  $[Al_2(SO_4)_3 \cdot 18H_2O]$ , 3 percent melamine formaldehyde wet strength resin, and the appropriate quantities of dyes. However, the Government makes no warranty that detector paper manufactured in this manner will meet the requirements of this specification. The requirements of this specification must be met regardless of the method of manufacture.

6.6 Supersession data. This specification supersedes and includes the requirements of Edgewood Arsenal Purchase Description 197-54-837, dated 4 October 1963.

Custodian:

Army - EA

Preparing activity:

Army - EA

Project No. 6665-A369

**SPECIFICATION ANALYSIS SHEET**Form Approved  
Budget Bureau No. 22-R255

**INSTRUCTIONS:** This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO (If "yes", in what way?)

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.)

SUBMITTED BY (Printed or typed name and activity - Optional)

DATE

**DD FORM 1426**  
1 JAN 66

REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED

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